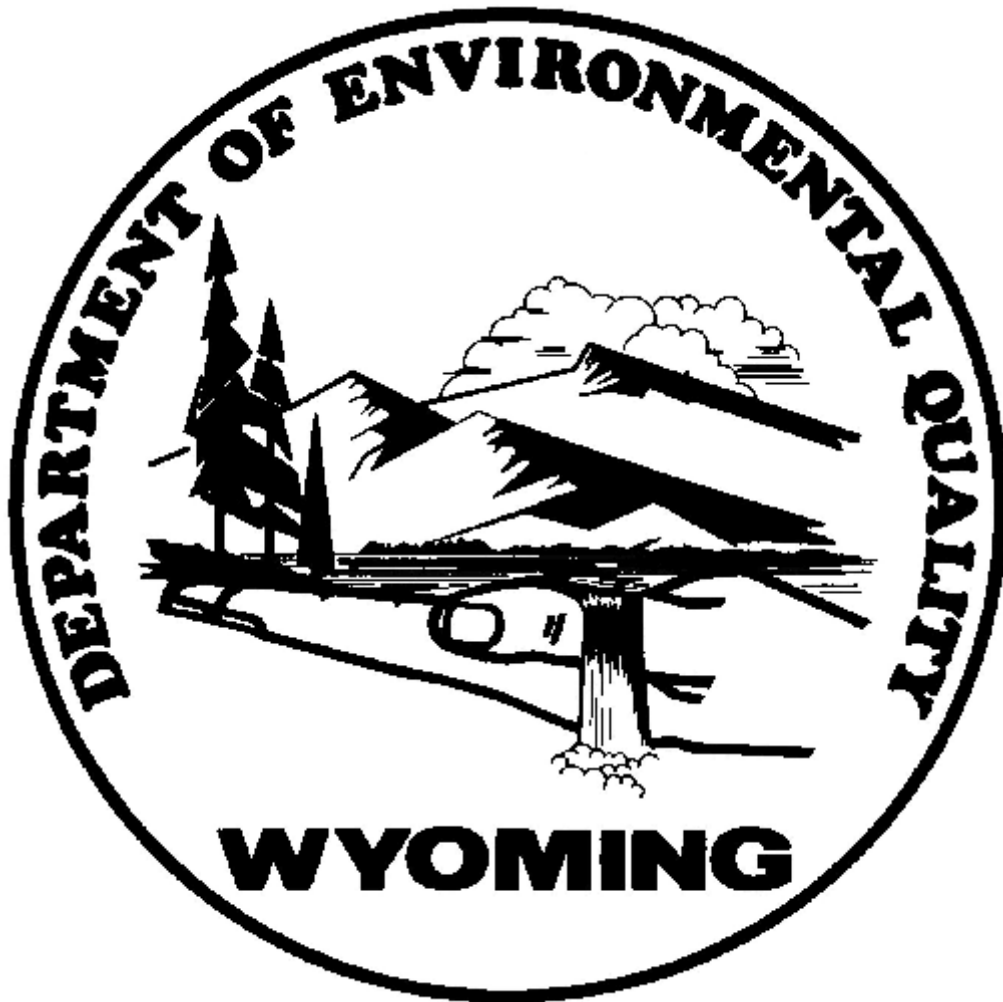


**DEPARTMENT OF ENVIRONMENTAL QUALITY
LAND QUALITY DIVISION**



GUIDELINE NO. 17

PERMANENT POSTMINE IMPOUNDMENTS

TABLE OF CONTENTS

INTRODUCTION	1
DEFINITIONS	1
I. COAL AND NONCOAL OPERATORS	2
A. Land Use	2
1. Appendix D-1	2
2. Appendix D-6	3
3. Appendix D-8	3
4. Reclamation Plan	3
B. Water Rights	4
C. Reclamation Performance Bond	4
D. Depressions and Playas	5
1. Premine Survey	5
2. Reconstruction Plan	5
II COAL MINES	6
A. Water Quality	6
1. General	7
2. Stockponds	7
3. Major Impoundments	7
B. Water Quantity	7
1. General	8
2. Stockponds	8

3.	Major Impoundments	8
C.	Reclamation Plan, Probable Hydrologic Consequences (PHC) Section	9
D.	Backfill Quality	9
1.	Stockponds	9
2.	Major Impoundments	9
E.	Performance Criteria	10
F.	Mid-course Evaluation Plan	11
G.	Design Criteria	11
1.	General Criteria	11
2.	Major Impoundments	13
3.	Design & Construction Suggestions	13
H.	Monitoring	14
I.	Special Bituminous Coal Mines	15
III.	NON COAL MINES	15
A.	Water Quality and Quantity	15
B.	Backfill Quality	16
C.	Design Criteria	16
D.	Monitoring	16

INTRODUCTION

This document is a **guideline only**. Its contents are not to be interpreted by applicants, operators, or Department of Environmental Quality, Land Quality Division (DEQ/LQD) staff as mandatory. This guideline is intended to assist operators in meeting requirements of the DEQ/LQD Coal and Non-Coal Rules and Regulations (R&R) concerning permanent postmine impoundments. It contains permitting requirements as well as recommendations for designing an impoundment which is consistent with a designated postmine land use(s). Permanent postmine impoundments may enhance the postmine environment if planned and constructed using a multi-disciplinary approach.

Permanent impoundments are allowed by Wyoming Statutes in accordance with W.S. §35-11-407. Cumulative postmine impoundment volumes and/or individual impoundment volumes should not exceed premine impoundment volumes by more than 10 percent without clear documentation of equal or better land use standards as required by Wyoming Statutes, W.S. §35-11-402 (a)(ii). Permanent postmine impoundments must be designed to be consistent with the existing/approved postmine land use as per W.S. §35-11-407.

All headings and/or subsections thereof may not apply to all operators/applicants. However, applicants should provide a comparison of premine and postmine impoundment characteristics, assuming the proposed impoundment(s) is a replacement feature(s). This guideline covers three types of impoundments; stockponds, major impoundments and specialized depressions-playas, all of which require a permit issued by the State Engineers Office (SEO). This guideline does not address wetlands.

DEFINITIONS

Stockpond: The total capacity must not exceed 20 acre-feet and the dam height must not be greater than 20 feet measured from the downstream toe to the top of the embankment. Stockponds must have a designed spillway to provide flow-through drainage.

Major Impoundment: Any impoundment that has a storage capacity of greater than 20 acre-feet and/or has an embankment height greater than 20 feet measured from the downstream toe to the top of the embankment. Major impoundments must have a designed spillway to provide flow-through drainage.

Depression-Playa: A closed basin impoundment which does not provide through drainage.

Replacement Features

1. *Replacement Stockpond:* A designated replacement feature whose volume when added to other designated replacement stockpond volumes does not exceed cumulative premine volume by more than 10 percent.
2. *Replacement Major Impoundment:* A one for one replacement of a premine feature and whose volume does not exceed that of the premine feature by more than 10 percent.
3. *Replacement Playa:* A one for one replacement of a premine feature and whose volume does not exceed that of the premine feature by more than 25 percent and areal extent by more than 10 percent.

Enhancement Features

1. *Enhancement Stockpond:* A designated feature whose volume when added to other designated replacement stockpond volumes exceeds the cumulative premine volume by more than 10 percent.
2. *Enhancement Major Impoundment:* A feature is a one for one replacement of a premine feature whose volume exceeds that of the premine feature by more than 10 percent or is an entirely new feature.

I. COAL AND NON-COAL OPERATORS

A. Land Use

W.S. §35-11-406 (b)(i) requires that all permits list past and present major premine land uses. W.S. §35-11-406 (b) requires a postmine land use plan which describes the postmine land uses.

W.S. §35-11-103(e)(xxvi) and (xxvii) define the land use categories of fish and wildlife habitat and grazingland, respectively. In general, all permits should list these two premine land uses. Coal R&R Chapter 1, Section 2.(bc)(i) through (xi) define a larger list of land uses.

The land use categories which directly apply to reclaimed lands with one or more permanent postmine impoundments include:

- | | |
|---------------------|-----------------------------|
| C grazingland | C fish and wildlife habitat |
| C recreational land | C developed water resources |

Coal R&R Chapter 2, Section 2.(b)(xiv) also requires justification for any change between premine and postmine land uses. This regulation also requires demonstration that altered postmine land use(s) is equal to or greater than replaced premine land use(s).

The permit must clearly state the premining and postmine land use(s). The permit must also clearly identify all changes from designated premine to postmine land use(s).

1. Appendix D-1

In order to support all postmine impoundments, Appendix D-1 should:

- a. List the premine land uses employing only the categories from W.S. §35-11-103(e), Coal R&R Chapter 1, Section 2.(bc)(i) - (xi) and Non-Coal R&R Chapter II, Section 2.(a)(i)(A);
- b. Tie land use categories to specific premine plant community types delineated in the premine vegetation inventory presented in Appendix D-8. This may be accomplished by a clear cross reference to such a discussion in Appendix D-8; and
- c. Address the issue of potential land use change should enhancement impoundments be proposed.

2. Appendix D-6

Appendix D-6 normally details permit area surface water characteristics. In relation to the issue of postmine impoundments, the following information should be documented for all premine impoundments:

- a. Known physical dimensions;
- b. SEO permit numbers for each impoundment (if the structure is permitted);
- c. Type of structure approved by SEO; and
- d. Any known premine water quality/quantity information and associated seasonal variability for each impoundment.

This documentation is crucial to establishing whether postmine impoundments are replacement structures or they are different structures which require land use changes. If a listing of premine impoundments does not exist in the approved permit, then the material must be submitted as a Form 11 Revision containing this baseline information.

3. Appendix D-8

This Appendix should clearly allocate the delineated premine plant community types to specific premine land use categories.

4. Reclamation Plan

The Reclamation Plan should include a specific section that:

- a. Lists the postmine land uses based only on categories from W.S. §35-11-103(e)(xxvi)(xxvii), Coal R&R Chapter 1, Section 2.(bc) and Non-Coal R&R Chapter II, Section 2.(b)(iii)(E)(I) and (II);
- b. Lists the postmine plant community types which comprise each postmine land use category;
- c. Demonstrates that the areal extent of each postmine land use category is equivalent to the corresponding premine land use category;
- d. Identifies postmine impoundments which the applicant considers to be replacement impoundments;
- e. Provide written consent for the permanent impoundment from the surface owner if different from the mineral owner; and
- f. Demonstrate that the size of the impoundment, contouring and revegetation are suitable for the designated postmine land use.

The cumulative postmine impoundment volume should not exceed the cumulative premine impoundment volume by more than 10 percent without clearly addressing the equal to or

greater than criteria of W.S. §35-11-402(a)(ii). Exceeding the 10 percent criterion requires the applicant to demonstrate that the postmine impoundment will function hydrologically and will support the designated postmine land use(s). Enhancement impoundments may also require a change in the postmine land use(s).

The DEQ/LQD will generally use SEO procedures for distinguishing between stockponds and larger impoundments. Generally, the SEO will approve structures whose capacity does not exceed 20 acre-feet and whose embankment does not exceed 20 feet in height, measured from the downstream toe, as a stockpond. The SEO and DEQ/LQD consider impoundments larger than these physical characteristics to be major impoundments.

The DEQ/LQD will consider larger volume, non-replacement postmine impoundments if they meet design criteria and permitting requirements outlined elsewhere in this document. These larger postmine impoundments will normally drive a change in land use. A specific section of the Reclamation Plan must justify each impoundment and demonstrate that the new land use category is equal to or greater than the premine land use. In order to approve change(s) in land use, the DEQ/LQD must determine that the proposed land use(s) is equal to or greater than the premine land use(s).

B. Water Rights

The applicant must obtain Wyoming SEO approval prior to submitting the permanent postmine impoundment proposal to DEQ/LQD.

C. Reclamation Performance Bond

Coal R&R Chapter 2, Section 2.(b)(iv)(E)(III) and Non-Coal R&R Chapter II, Section 2(b)(iii)(E)(III) requires the DEQ/LQD Administrator to declare that the projected water quality and quantity will support the postmine land use(s) associated with that permanent impoundment. This regulation also allows the DEQ/LQD Administrator to require an Alternate Reclamation Plan for the impoundment site.

The DEQ/LQD generally maintains that each designated replacement stockpond meet the design criteria outlined in this document. There is no need for an Alternate Reclamation Plan. However, the DEQ/LQD may require an Alternate Reclamation Plan in the permit's Reclamation Plan for major impoundments. The alternate plan usually consists of backfilling and reclaiming the site to blend with surrounding topography and achieves through drainage.

If an Alternate Reclamation Plan is required, costs must be included in the Bond the year prior to the initial disturbance of the impoundment footprint. The DEQ/LQD prefers the bond costs be calculated as a distinct and separate line item under Section E.2.(F) of the DEQ/LQD Standardized Bond Format (DEQ/LQD Guideline No. 12). The line item entry should:

1. Identify the source of backfill and topsoil and associated haul distances;
2. List the equipment costs associated with this alternate plan; and
3. Identify the approved permanent seed mix and associated purchase and planting costs.

This Guideline also outlines procedures for a "Mid-Course Evaluation" of the permittee's progress toward achievement of the permanent impoundment construction and water quality and quantity performance standards. If the Mid-Course Evaluation finds satisfactory progress, the permittee may petition the DEQ/LQD to remove the requirement for an Alternate Reclamation Plan.

D. Depressions and Playas

1. Premine Survey

A depression is a topographic feature which does not provide flow-through drainage. For coal mine operations, commensurate with the Approximate Original Contour (AOC) concept, depressions are not allowed unless they are shown to replace premine features. For Non-Coal operations, operators are required to reestablish through drainage per Non-Coal R&R Chapter III, Section 2.(b)(i)(B). Since depressions will only be allowed as replacement features, it is important that a premine survey be conducted to establish the characteristics and functions of said feature. The premine survey should consist of the following:

- a. Document any specialized land use in Appendix D-1;
- b. Identify the soil texture and type of topsoil and subsoil in Appendix D-7 or D-10;
- c. Identify the vegetation and/or plant community type in Appendix D-8 and D-10;
- d. Identify wildlife habitat and usage in Appendix D-9;
- e. Determine the essential hydrologic function(s) and morphology in Appendix D-6; and
- f. Illustrate the location of the feature on a premine map.

2. Reconstruction Plan

Replacement of the premine depression feature will require specialized reconstruction procedures and defined performance criteria to evaluate reclamation success. The reconstruction plan should include the following:

- a. Postmine depressions must support the approved postmine land use(s). Postmine depressions may not alter land use without formal approval and the operator must demonstrate the restored depression will provide an "equal to or greater than" land use. The demonstration must extend across the minimum bond period;
- b. Postmine depression drainage area should approximate the premine drainage area, generally to within ± 10 percent;
- c. Several premine depressions should not be combined into one postmine depression unless it can be demonstrated as necessary to achieve the designated postmine land use;
- d. The volume and surface area of the postmine depression should be within ± 25 percent and ± 10 percent of the premine volume and surface area, respectively. In addition, the morphology (length, width, and depth) of the postmine feature should approximate that of the premine feature;

- e. The location of the postmine depression should approximate the premine location and not disrupt postmine drainage patterns;
- f. The accumulation of fine-grained deposits, which settle to the bottom of the depression, are essential to the establishment of the depression's function. Thus, depression orientation should be considered in the postmine design; and
- g. All surface and ground water aspects of the postmine feature must be outlined, including:
 - (1) Water yield from a design event;
 - (2) Water quality of the premine and postmine depression;
 - (3) Seepage rates from the ponded area;
 - (4) Ground water recharge from seepage;
 - (5) Project any ground water inflows; and
 - (6) Project any surface/ground water interaction.
- h. Identify soil characteristics and thickness; demonstrate that the postmine soils will mimic premine conditions. In order to create a similar hydrologic environment, this may require special handling of material;
- i. Evaluate the sedimentation rate such that depression life predictions can be made; and
- j. The reclamation seed mix should be developed in consideration of the species present in the premine playas and those present in established control/referenced/extended reference areas. Generally, the seed mix should contain as many premine species as possible.

There is some cause for concern about the replacement of specialized depressions because records of successful, long term restoration are nonexistent. Specific bond release criteria should be developed with goals to be met throughout the bond period.

II. COAL MINES

A. Water Quality

Impoundment water quality must be appropriate for the designated postmine land use. DEQ/Water Quality Division (WQD) ground water quality standards are used as performance criteria for bond release. If the impoundment is a **replacement feature**, then the performance standards will be based on class of use or premine condition if the feature met or exceeded class of use standards. If the impoundment is an **enhancement feature** then it must meet class of use standards. WQD R&R's Chapter 1, Sections 22-31 and Appendix B, Chapter 8, Section 5.(e) and Chapter 8, Table 1 identify the water quality standards for various classes of use. Water quality performance standards selected for each postmine impoundment must be achieved prior to final bond release.

1. General

Permit text, in a specific Reclamation Plan section, shall provide assessments detailed enough for the Administrator to determine the probable hydrologic impacts on ground and surface water systems regarding postmine impoundments, R&R Chapter 19, Section 2.(a)(i).

2. Stockponds

DEQ/LQD recognizes that water quality can diminish with time due to evaporative losses. Thus, water quality samples should be obtained during a period shortly after spring runoff or an event which produces significant runoff. The parameters to be sampled can be found in DEQ/LQD's Guideline 8.

a. Replacement stockponds

- (1) Water quality must meet Class III (Livestock) standards (ground water) as set by DEQ/WQD; or
- (2) Water quality must be similar to that measured during baseline studies or measured from a nearby stockpond unaffected by mining activity.

b. Enhancement stockpond water quality must meet Class III (Livestock) standards (ground water) as set by DEQ/WQD.

3. Major Impoundments

In addition to the standards and requirements outlined above, the design and discussion of all large impoundments must:

- a. Include a predicted salt accumulation analysis derived from an accepted/tested model. Modeling will be accomplished using predicted inflows and outflows while including wet and dry periods. (If impoundments similar in size and other physical dimensions exist within the vicinity, measurements from these structures may be substituted.);
- b. Predict the likelihood of water contamination by toxic compounds, known or identified through sampling, for a sufficient time period using an accepted model or method;
- c. Demonstrate that ground water inflows, if applicable, will not negatively impact the impoundment's water quality with regard to land use. The length of time before ground water interacts with the impoundment should also be accounted for during this assessment; and
- d. Predict sediment accumulation to determine structure life.

B. Water Quantity

The quantity of water available to be delivered to an impoundment must be commensurate with impoundment capacity.

1. General
 - a. An assessment of reclamation operations which may affect ground and surface water quantity both on and off the mine site must be provided. R&R Chapter 19, Section 2.(a)(i). This assessment shall include:
 - (1) Timing and availability of water; and
 - (2) Affects on the stream channel. Changes in channel morphology, hydrologic balance, and function of landforms, such as AVFs, playas, wetlands, etc..
 - b. Assessments shall be in sufficient detail to enable the Administrator to determine the probable hydrologic impacts on ground and surface water systems. R&R Chapter 19, Section 2.(a)(i).

Applicants should also consider the issues listed below related to water quantity. These issues are divided by size of impoundment. All issues related to stockponds also apply to major impoundments.

2. Stockponds
 - a. Stockponds must hold water seasonally in response to spring runoff or extreme events. The quantity of water must support the postmine land use.
 - b. Discharges from the stockpond must not degrade the receiving waters or induce erosion in the downstream channel, causing channel instability.
3. Major Impoundments
 - a. Provide a long-term water balance to predict fill/spill times and functionality of the impoundment. Wet and dry climatic periods must be considered in the assessment.
 - b. Water balance models must run for a time period sufficient (e.g., at least 25 years) to evaluate the impoundment's long-term function and performance.
 - c. Water balance models should include a sensitivity analysis for each model parameter.
 - d. No ground water well pumpage will be allowed for filling purposes. The applicant may utilize ground water discharge and/or pit pumpage (dewatering) to fill the impoundment.
 - e. If synthetic data are used for surface water flows, applicants must provide correlation equations. This must include the R-squared value and standard error in order to determine the prediction's confidence interval.
 - f. All unchannelized direct flows must be accounted for through the use of a rainfall-runoff model or other acceptable method.
 - g. Gaging stations and monitoring wells should be installed to verify inflow and outflow predictions.

- h. All large permanent impoundments must hold water year round.
- i. DEQ/LQD may impose requirements on the maximum acceptable water level fluctuation.
- j. The quantity of water delivered must be sufficient to spill at least once every 10 years. Spillage or overflow will help to maintain the designated water quality condition and the downstream channel morphology.
- k. The permit must define a fill time which is directly tied to timely construction and/or reconstruction of the impoundment and its drainage basin. Fill and spill times must not extend more than 10 years beyond completion of reclamation.

C. Reclamation Plan, Probable Hydrologic Consequences (PHC) Section

The applicant must update the probable hydrologic consequences section as necessary in accordance with R&R Chapter 13, Section 1.(d)(iv)(D). Results of the water quality and quantity modeling will be analyzed with regard to their impact on the hydrologic balance.

D. Backfill Quality

1. Stockponds

Backfill quality under and around each stockpond should be verified by methods specified in the permit for general backfill. As long as the postmine impoundment is designated as a stockpond, no additional site specific backfill sampling required.

2. Major Impoundments

These permanent postmine features require an enhanced backfill quality sampling regime whose components are determined by the type of predicted inflow(s).

a. Surface Water Inflow Only

The sampling scheme outlined below applies to the area below the impoundment's established high water line. Backfill above the impoundment's established high water line and immediate surrounding area should be sampled according to permit commitments associated with backfill quality demonstration procedures. These commitments may include:

- (1) Drilling on a grid pattern with no larger than 500-foot centers for general backfill requirements and on 250-foot centers exclusively for Selenium sampling;
- (2) Drilling to a total depth of 4 feet, compositing two samples; one from 0 to 2 feet and the other from 2 to 4 feet;
- (3) Analyzing for a suite of parameters similar to other permit commitments associated with backfill quality demonstration procedures; and

- (4) Outlining supplemental sampling procedures which will be used when the initial sampling regime identifies questionable or unsuitable material.

b. Surface and Ground Water Inflows

When a major impoundment will receive both surface and ground water inflows, the backfill quality within the cone of depression and/or the radius of endangering influence must be selectively sampled by a program (unless the operator has an approved regrade spoil sampling plan) which includes:

- (1) Sampling locations should be installed in a radial pattern originating at the approximate center of the impoundment and located along radii spaced approximately 45 degrees apart. Sampling locations are situated approximately equal distance between center of impoundment and estimated high water line;
- (2) Drilling to a total depth equal to the bottom elevation of the impoundment;
- (3) Taking at least three individual samples across the total depth of each hole which then may be composited, not to exceed 10-foot increments, into a single sample for analysis;
- (4) Analyzing samples for a suite of parameters which are comparable to those used in defining the WQD "Class of Use" for the impoundment water quality; and
- (5) Implementing the supplemental sampling procedure identified in the permit text should the initial sampling regime identify questionable or unsuitable backfill.

E. Performance Criteria

The applicant shall provide a set of performance criteria to which the impoundment's functional success can be evaluated. Performance criteria for enhancement features and large impoundments should include the following:

1. Quantity of inflows and outflows;
2. Average time between spills;
3. Water quality standards for the impoundment;
4. Annual water level fluctuation;
5. Effects on downstream water rights, hydrologic balance, and downstream hydrologic features, such as AVFs and wetlands;
6. Impoundment seepage losses.
7. Evaporative losses.

F. Mid-Course Evaluation Plan

This section is only applicable to major impoundments. Applicants must commit to meet with DEQ/LQD at least once during the 10-year interim period prior to bond release to assess the impoundment's ability to meet performance criteria. Performance criteria may include, but are not limited to, water quality standards, water elevation levels, and inflow/outflow quantities. The Mid-Course Evaluation Plan should outline specific performance criteria objectives and be identified as a separate Reclamation Plan section. Listed below are major elements which will be evaluated during the mid-course evaluation.

1. Water quality data collected during the interim period should be compared to predicted values. The water quality model should be calibrated and re-run using the parameter values obtained prior to the evaluation period. If model predictions and/or collected data indicate water quality is restricting the impoundment from fulfilling its designated land use(s), an Alternate Reclamation Plan may be implemented.
2. Impoundment water level data collected during the interim should be compared to predicted water levels. The water balance model should be calibrated and re-run using data collected during the interim evaluation period. If predicted time to fill and/or spill frequency appears to significantly exceed the predictions, more than 3 years, then the Alternate Reclamation Plan may be implemented.
3. Model values used for seepage and evaporation losses should be checked against those obtained during the interim period. The water balance model should be re-calibrated accordingly.
4. If synthetic inflow data were used during modeling, they should be compared to data obtained during the interim to determine if flow magnitudes are reasonable.

G. Design Criteria

There are numerous DEQ/LQD permit requirements for permanent postmine impoundments. Applicants should also check with other agencies involved in the permitting process to determine if additional design information and criteria are required. The following list identifies DEQ/LQD requirements found in the Coal Rules and Regulations.

1. General Criteria
 - a. Written consent of the landowner. R&R Chapter 2, Section 2.(b)(iv)(E)(I) and Chapter 4, Section 2.(g)(i)(C).
 - b. State the source, quality, and quantity of water available for impoundment and its suitability for the designated land use. R&R Chapter 2, Section 2.(b)(iv)(E)(II) and Chapter 4, Section 2.(g)(i)(A).
 - c. Describe the proposed use of the impoundment. R&R Chapter 2, Section 2.(b)(iv)(E)(II).
 - d. Location map. R&R Chapter 2, Section 2.(b)(iv)(B)(I).

- e. Contour map clearly showing impoundment slopes. R&R Chapter 2, Section 2.(iv)(B)(III).
- f. Cross sections delineating the high water mark and the predicted 25-year zone of water level fluctuation which will establish the "low" flow mark. R&R Chapter 2, Section 2.(iv)(B)(III).
- g. Graphs showing an area-capacity curve. R&R Chapter 4, Section 2.(g)(iv)(K).
- h. The design, construction, and maintenance of permanent impoundments shall be approved by the SEO. R&R Chapter 4, Section 2.(g)(iv).
- i. Provide procedures for riprapping, concreting or otherwise stabilizing the below-water portion of the embankments. R&R Chapter 4, Section 2.(g)(iv)(C)
- j. The embankment and its foundation and abutments must be stable which must include the removal of all vegetative and organic matter. R&R Chapter 4, Section 2.(g)(iv)(D) and (E).
- k. Provide procedures to revegetate the above-water face of the embankment and the surrounding areas according to approved permit procedures. R&R Chapter 4, Section 2.(g)(iv)(C).
- l. Dams must contain an overflow notch and spillway so as to prevent failure by overfilling and washing. R&R Chapter 4, Section 2.(g)(ii)(A).
- m. Spillways must be able to accommodate the 100-year, 6-hour storm event or a storm duration with a larger peakflow as required by the Administrator. If grass-lined spillways are used, the velocity and depth of flow should be determined for both active and dormant vegetation. R&R Chapter 4, Section 2.(g)(vi).
- n. Demonstrate that discharges from the impoundment will not degrade the receiving waters. R&R Chapter 4, Section 2.(g)(i)(B).
- o. All exposed coal seams remaining after mining and any acid-forming materials which are exposed shall be buried by an acceptable depth of material. R&R Chapter 4, Section 2.(c)(xiii)(A).
- p. All mineral seams and other sources of possible water contamination within the impoundment basin are covered or stabilized so as to prevent contamination of the impounded water. R&R Chapter 4, Section 2.(g)(ii)(C)
- q. Bentonite or other mire producing material within the impoundment basin shall be removed or covered with suitable materials. R&R Chapter 4, Section 2.(g)(ii)(D).
- r. Demonstrate that reclaimed slopes surrounding the impoundment do not present a safety hazard and that the slopes can be revegetated using approved permit procedures. R&R Chapter 4, Section 2.(g)(ii)(B).

- s. Vertical portions of any remaining highwall must be far enough below the low water mark so as to provide adequate safety and access. R&R Chapter 4, Section 2.(g)(iv)(B)
- t. Demonstrate that within the radius of ground water influence that all unsuitable materials will not degrade the water quality within the impoundment. No toxic or hazardous material shall be buried beneath the impoundment basin. R&R Chapter 4, Section 2.(c)(xiii)(B).
- u. Designs must be certified by a Professional Engineer. R&R Chapter 4, Section 2.(g)(iv)(A).

2. Major Impoundments

Major Impoundments are defined as those having an elevation difference of 20 feet or greater from the downstream toe to the top of the embankment, have a storage volume of greater than 20 acre-feet and remain on the postmine landscape as per R&R Chapter 4, Section 2.(g)(iii).

- a. Embankments and foundations must be stable and meet a static safety factor of 1.5 and a seismic factor of 1.2. R&R Chapter 4, Section 2.(g)(iv)(D).
- b. Submit designs to the District MSHA manager and provide verification of that submittal. R&R Chapter 4, Section 2.(g)(iv)(K).

3. Design and Construction Suggestions

Design criteria which are suggested for impoundment construction include the following, many of which are associated with the designated postmine land use(s). Many of the criteria listed below are associated with a fish and wildlife habitat designation. The applicant should consider these items in relation to designated postmine land use(s) in the design and construction of postmine impoundments.

- a. Applicants should evaluate wind generated wave erosion of impoundment banks. Aeration of impoundment water will be aided by wave action, but the prevalence and prolonged nature of windy days suggests erosion is more of a concern. Ideally, the impoundment's long axis would be oriented perpendicular to the prevailing wind direction. Possible alternatives would include constructing the impoundment in a "U" or "L" shape.
- b. Limit access during filling to minimize hazard problems, enhance vegetation growth, and promote bank stability.
- c. Impoundment bottom contours should be irregular to provide a variety of bottom types.
- d. Water should be at least 15 feet deep over 40 percent of the impoundment area to provide thermal protection and a well balanced ecosystem.
- e. Shoreline development index (shoreline length divided by the circumference of a circle with equal area) should be a minimum of 2.2.

- f. Littoral zones, areas having a maximum depth of 10 feet, should occupy at a minimum 20 percent of the impoundment area. A minimum of 5 percent of the impoundment area should be less than 3 feet deep.
- g. Islands are useful in reducing wave generated erosion impacts and improving wildlife and fisheries habitat.
 - (1) Islands should be separated from the mainland by at least 60 feet of water 2 feet deep.
 - (2) In large impoundments with a surface area greater than 50 acres, several small islands are preferable to one large island.
 - (3) Islands should be capped with a minimum of 10 inches of soil to provide a suitable medium for plant growth.
 - (4) Shoreline complexity should increase with island size. The top of the island should be at least 3 feet higher than the average spring runoff water level elevation.
 - (5) Island shorelines should have adequate erosion protection. For example, riprap may be necessary.

H. Monitoring

DEQ/LQD monitoring requirements cover a wide variety of disciplines, ranging from water quality/quantity to structural integrity.

- 1. During construction, upon completion, and until final bond release, the impoundment shall be inspected for structural integrity. R&R Chapter 4, Section 2.(g)(iv)(F) & (G).
- 2. Applicants shall establish quantity ground and surface water monitoring stations to determine the extent of the disturbance to hydrologic balance. R&R Chapter 4, Section 2.(i).
 - a. Streamflow monitoring stations should be established to determine impoundment inflows and assess impacts to downstream water rights.
 - b. Monitoring wells surrounding impoundments should be placed in a radial pattern originating from the approximate center of the impoundment and located along radii spaced approximately 45 degrees apart. The purpose of monitoring wells is to determine the recharge/discharge relationship between the impoundment and surrounding aquifer. Water levels should be recorded quarterly.
 - c. Impoundment water elevations should be recorded monthly for assessing the accuracy of the water balance and long term impoundment function.
 - d. Establish a precipitation gaging station within the contributing drainage basin. Daily records must be kept for this station.

3. Applicants should establish ground and surface water monitoring sites to determine water quality which is directly tied to the postmine land use. Applicants must be able to determine if their activities have degraded the quality of receiving waters and ultimately impeded the attainment of the designated postmine land use. R&R Chapter 4, Section 2.(viii)(i).
 - a. Ground water quality will be monitored quarterly, this frequency being possibly reduced after a period of 5 years. The applicable parameters can be found in Guideline 8.
 - b. Surface water quality will be monitored monthly; the frequency may be reduced after a period of 5 years. The applicable parameters are found in Guideline 8.
 - c. Impoundment water quality will be measured quarterly using the surface water parameters in Guideline 8. Samples should be depth integrated, if possible, otherwise samples should be procured at different depths. Depth measurements should be taken during water quality sampling periods.
 - d. All water quality samples should be collected, preserved, and analyzed according to Standard Methods for the Examination of Water and Wastewater.
4. Applicants must demonstrate that they have established and/or restored the stream channel characteristics, including aquatic habitats, to approximate premine stream channel characteristics. They must also demonstrate they have established and/or restored erosionally stable stream channels and flood plains. R&R Chapter 4, Section 2.(e)(i)(E)(II) & (III).
 - a. Geomorphic monitoring stations may be established downstream from the impoundment upon completion of construction. Annual measurements should include a longitudinal and a number of cross-sectional profiles. Photo documentation of the stream channel should be included to document any stability problems.
 - b. If a hydrologic feature, such as a wetland or AVF exists downstream from the impoundment, alluvial wells may be required to demonstrate that their function has not been jeopardized.
5. All impoundments shall be inspected regularly during and immediately after construction by a professional engineer. Immediately following each inspection, a report shall be prepared and certified by the engineer describing the construction work observed and its conformance with the approved designs. All inspection reports shall be retained at the mine site and submitted in the Annual Report to the Administrator. R&R Chapter 4, Section 2.(g)(iv)(F).
6. Permit commitments to monitor all permanent vegetative communities using the approved interim vegetation monitoring methodology shall be followed for areas in and adjacent to the impoundments.

I. Special Bituminous Coal Mines

If the applicant is considered a Special Bituminous Coal Mine, DEQ/LQD R&R Chapter 8 should be consulted, as not all of the prior requirements apply.

III. NON COAL MINES

The Non-Coal R&R do not distinguish among sizes (e.g., Major Impoundment) and types (Stockponds) of structures. Therefore, the LQD will utilize the definitions established by the SEO to distinguish between sizes and types of permanent postmine impoundments.

A. Water Quality and Quantity

1. A statement of the source, quality and quantity available for impoundment and a statement regarding its suitability for the designated postmine land use(s). R&R Chapter II, Section 2.(b)(iii)(E).

B. Backfill Quality

1. All sources of possible water contamination within the impoundment must be covered with overburden or stabilized in such a manner so as not to contaminate impounded water. R&R Chapter III, Section 2.(b)(iii)(B) and (g)(iii).
2. Bentonite or other mire-producing material within the impoundment shall be removed or covered with material which will prevent hazards to man or beast. R&R Chapter III, Section 2.(g)(iv).

C. Design Criteria

1. Provide graded and contoured access to the impoundment. R&R Chapter III, Section 2.(b)(ii) & (iii).
2. Slopes around impoundments must be gentle enough so as not to present a safety hazard to humans or livestock. R&R Chapter III, Section 2.(g)(ii).
3. Pitwalls may be allowed on half or less of the impoundment's shoreline provided they are stabilized using an acceptable method, such as terracing. R&R Chapter III, Section 2.(b)(ii)(C) and (iii)(B).
4. Exposed areas surrounding the impoundment must be sloped, graded and contoured so as to provide for revegetation. R&R Chapter III, Section 2.(b)(ii)(C) and (g)(ii).
5. Dams must contain an overflow notch and spillway so as to prevent failure by overfilling. Notches and spillways must be riprapped with rock or concrete to prevent erosion. R&R Chapter III, Section 2.(g)(i).
6. The impoundment dam construction will be so designed to insure permanent stability and to prevent safety hazards. W.S. §35-11-407(a)(iii).
7. Applications must show the anticipated high and low water levels for permanent impoundments. R&R Chapter II, Section 2.(a)(iii)(B)(III).

D. Monitoring

1. The Administrator may require monitoring of surface and ground water associated with permanent impoundments. Any monitoring plan developed should be intergrated with final quality and quantity bond release standards. R&R Chapter II, Section 2.(b)(iii)(E)(IV).